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ORIGINAL (Red)

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EXECUTIVE SUMMARY REPORT
HALBY CHEMICAL SITE
WILMINGTON, DE

JULY 1996

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TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

1.1 Objectives of the Study

The objective of this study was for the Response Engineering and Analytical Contract (REAC) to provide technical support to the United States Environmental Protection Agency's Environmental Response Team Center (U.S. EPA/ERTC) in the evaluation of the potential impact associated with soil vapors and air emissions from the Halby Chemical site. The technical support included the following tasks: 1) Monitor ambient air with the SCIEX™ Trace Atmospheric Gas Analyzer (TAGA) 6000E Mass Spectrometer/Mass Spectrometer (MS/MS) at selected locations on the site to determine if target compounds were present. 2) Perform sector sampling on-site during 10-hour periods to determine if target compounds were present. 3) Perform Open Path Fourier Transform Infrared (OP-FTIR) monitoring to determine if target compounds were present. 4) Collect air samples on carbon tubes to determine if target compounds were present.

The contaminants of concern for ambient air monitoring and sampling were ammonia, ethylthiocyanate, ethylisothiocyanate, carbon disulfide, carbonyl sulfide, NIOSH method 1403 compounds, aromatic and aliphatic amines, volatile organic compounds (VOCs) following a modified Toxic Organic EPA TO-14 compound lists, and the NIOSH methods 1500, 1501, and 1003 compound lists.

1.2 Site Background

The Halby Chemical site is approximately 13 acres in size and is located in Wilmington, New Castle County, DE. The triangular shaped site is located in a highly industrialized area near the Port of Wilmington and is bordered by the Conrail Railroad to the northeast, U.S. Interstate 495 to the northwest, and Terminal Avenue to the south. Tidal freshwater wetlands associated with the Christina River lie adjacent to the eastern boundary of the site. An inactive chemical manufacturing facility and container storage area is present in the southeastern portion of the site. A 2.5-acre area of degraded tidal wetlands, referred to by the owners as a lagoon, exists along a railroad bed in the northeastern portion of the site.

2.0 METHODOLOGY

2.1 Trace Atmospheric Gas Analyzer 6000E Mass Spectrometer/Mass Spectrometer

2.1.1 General Theory

The TAGA 6000E mass spectrometer/mass spectrometer (MS/MS) is a direct air sampling instrument capable of detecting, in real time, trace levels of many organic compounds in ambient air. The technique of triple quadrupole MS/MS is used to differentiate and quantitate compounds.

The initial step in the MS/MS process involves simultaneous chemical ionization of the compounds present in a sample of ambient air. The ionization produces either positive or negative ions by donating or removing one or more electrons. The chemical ionization is a "soft" ionization technique which allows ions to be formed with little or no structural fragmentation. These ions are called parent ions.

The parent ions with different mass-to-charge (m/z) ratios are separated by the first quadrupole (the first MS of the MS/MS system). The quadrupole scans selected m/z ratios allowing only the parent ions with these ratios to pass through the quadrupole. Parent ions with m/z ratios different than those selected are discriminated electronically and fail to pass through the quadrupole.

The parent ions selected in the first quadrupole are accelerated through a cloud of uncharged argon atoms which is introduced normal to the ion path in the second quadrupole. A portion of the parent ions entering the second quadrupole fragment as they collide with the argon atoms. These fragmented ions are called daughter ions. This process, in the second quadrupole, is called collision induced dissociation (CID).

The daughter ions are separated according to their m/z ratios by the third quadrupole (the second MS of the MS/MS system). The quadrupole scans selected m/z ratios, allowing only the daughter ions with these ratios to pass through the quadrupole. Daughter ions with m/z ratios different than those selected are discriminated electronically and fail to pass through the quadrupole. Daughter ions with the selected m/z ratios are then counted by an electron multiplier. The resulting signals are measured in ion counts per second (ICPS) for each parent/daughter ion pair selected. The intensity of the ICPS for each parent/daughter ion pair is directly proportional to the ambient air concentration of the organic compound that produced the ion pair.

2.1.2 Monitoring Strategy

The TAGA was fitted with the low pressure chemical ionization (LPCI) source on 23 and 24 April 1996. Monitoring was performed using a selected ion technique to qualitatively and quantitatively identify the following compounds: benzene; toluene; xylenes; vinyl chloride; trichloroethene; tetrachloroethene; trans-1,2-dichloroethene; ethylthiocyanate; and ethylisothiocyanate. These compounds were selected based on information provided by the U.S. EPA Region III and availability of standards. In addition to the selected ion monitoring, parent ion and daughter ion spectra were collected when the TAGA was sampling downwind of the excavation activities to determine if other compounds were present.

The TAGA was fitted with the atmospheric chemical ionization (APCI) source on 25 April 1996. Parent ion and daughter ion spectra were collected when the TAGA was sampling downwind of the excavation activities to determine what compounds were present.

2.2 Sector Sampling

The XonTech Model 911A Air Sampler (sector sampler) is designed to collect air samples at a constant flow rate for a selected sampling time into a evacuated stainless steel SUMMA canister. The sector sampler collects samples into the SUMMA canisters based on preset meteorological indices, wind speed and direction. The sector sampler can collect up to two air samples per unit when the preset meteorological conditions are met. As a result, air samples from one or more discrete areas can be collected separately. Typically, an "in sector" air sample (originating from the suspected area of contamination) and an "out sector" air sample (representing baseline or background) can be taken. Additionally, sector samplers can be set up to collect a single air sample with one sampler situated for a background or baseline sample and an additional sampler situated downwind of the source of contamination. The sector samplers are equipped with a wind speed cutoff and meteorological sensor interface designed to accept external wind speed and direction signals, to start and stop sampling whenever the wind speed is above or below a selected threshold, and the wind direction is in sector.

The pressure in the manifold is regulated by an adjustable relief valve at 25 pounds per square inch gauge (psig). This serves as the fixed upstream reference for the flow controller. The sample flows through the flow controller at a constant flow, independent of the canister pressure, and into the canister.

At the end of the sampling period, the SUMMA canisters, after properly documented for sampling time and final canister pressure, were stored in their respective containers for shipment to the REAC

laboratory in Edison, NJ, and subsequent analysis by gas chromatography/mass spectrometry (GC/MS). Analysis was performed according to U.S. EPA Method TO-14, *Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using SUMMA Passivated Canister Sampling and Gas Chromatographic Analysis*.

2.2.1 Sector Sampling Locations

Four stations were selected for sector sampling. At a minimum, one station was located upwind of the site and three were located downwind of the site. The number and location of the stations are as follows:

1. Sector Sampling Station SS-1 located near the southwest corner of the site.
2. Sector Sampling Station SS-2 located near the southeast corner of the site.
3. Sector Sampling Station SS-3 located near the northwest corner of the site.
4. Sector Sampling Station SS-4 located near the northeast corner of the site.

2.3 SUMMA Canister "Grab" Samples

In addition to the SUMMA canisters collected during sector sampling, "grab" samples were also taken. A "grab" sample is collected by drawing a gas sample into a SUMMA canister using the pressure difference between the atmosphere and an evacuated SUMMA canister. A total of seven "grab" samples were collected at the edge of the pits during trenching activities on 23, 24, and 25 April 1996. On 24 April 1996, a "grab" sample was collected from the Engineer's Room on the upper level of the Halby Chemical office building.

2.4 Silica Gel Tube Sampling for Aromatic and Aliphatic Amines

On 23 and 24 April 1996, air sampling for aromatic and aliphatic amines was conducted using a sampling train consisting of a SKC personal sampling pump connected to a 225-milligram (mg) silica gel sorbent tube. The sampling locations used on 23 April 1996, were the same used for the sector samplers (Locations 1 through 4). On 24 April 1996, trenching activities moved across the railroad tracks to an area adjacent to the lagoons. Four locations were established around the excavation area. These locations were labeled 5 through 8. A flow rate of 200 cubic centimeters per minute (cc/min) was pulled through the sorbent tube for approximately 400 minutes. A total of eight silica gel tubes were sampled and analyzed following NIOSH methods 2002 and 2010, Aromatic and Aliphatic Amines. Samples, along with quality assurance samples (lot and field blanks), were packaged and shipped to Clayton Environmental Consultants, Nobi, MI for analysis.

2.5 Charcoal Tube Sampling for Volatile Organic Compounds

On 24 April 1996, air sampling for VOCs was conducted using a sampling train consisting of a SKC personal sampling pump connected by tygon tubing to a 600-mg charcoal sorbent tube. The sampling locations were the ones used for aromatic and aliphatic amines on this day (Locations 5 through 8). A flow rate of 500 cc/min was pulled through the sorbent tube for approximately 400 minutes. A total of four charcoal tubes were sampled and analyzed following NIOSH methods 1500, 1501, and 1003 for the analysis of hydrocarbons. There was a modification to the sampling procedures by substituting a 600-mg charcoal tube for the 150-mg tube used in the methods. At the end of each sampling period, samples along with quality assurance samples (lot, field, and trip blanks) were packaged and shipped to the ERT/REAC laboratory in Edison, NJ for GC/MS analysis.

2.6 Charcoal Tube Sampling for Alcohols

Three locations, labeled 9, 10, and 11, were established around Pit 1. A flow rate of 200 cc/min was

pulled through the sorbent tube for approximately 400 minutes. A total of three charcoal tubes were sampled and analyzed following NIOSH method 1403, Alcohols IV. There was a modification to the sampling procedures by substituting a 600-mg charcoal tube for the 150-mg tube used in the method. Samples along with quality assurance samples (lot and field blanks) were packaged and shipped to Clayton Environmental Consultants, Nobi, MI for analysis.

2.7 Open Path Fourier Transform Infrared Monitoring

2.7.1 Theory

Remote optical sensing is generally set up to transmit a beam of radiation across a parcel of air to be measured. In an unistatic configuration, the transmitter and receiver are collocated and a retroreflector is used to reflect the transmitted radiation back to the receiver. The molecules in the beam's path absorb some of the radiation at certain wavelengths resulting in the reduction of the intensity of the beam at that wavelength to a value I. The ratio of the measured intensities, I/I_o (I_o is the intensity that would be measured in absence of molecular absorption), which is also defined as the transmittance, T, is related to the concentration, C, of the absorbing gas by the Beer-Lambert-Bouguer (BLB) law:

$$I(v)/I_o(v) = \exp(-A(v))$$

and $$A(v) = \alpha_m(v)CL$$

where:
- $A(v)$ = is the absorbance
- $\alpha_m(v)$ = is the instrument-independent molecular absorption coefficient associated with the collision-broadened absorption spectra of gases under standard atmospheric conditions
- L = is the path-length of the radiation through the gas

I, I_o, A, and α_m are functions of the radiation frequency, v, which is proportional to the reciprocal of the wavelength.

In the second equation, the absorbance, A(v), is proportional to the concentration-path product, CL. The proportionality constant is the molecular absorption coefficient, $\alpha_m(v)$, which is unique for each molecule and, thus, the source of the unique "fingerprint" shapes of the absorption spectra of the different molecules. These absorption features also have temperature and pressure (altitude) dependencies. The Infrared spectral region is 3-13 microns.

Gaseous contaminant concentrations are generally reported in unit of mass of contaminant per volume of gas, such as micrograms per cubic meter ($\mu g/m^3$), or volume of contaminant per volume of gas, such as parts per million by volume (ppmv) or parts per billion by volume (ppbv). Path-integrated concentrations, however, are typically reported in units of micrograms per square meter ($\mu g/m^2$) or ppm-meters (ppm-m). With an open-path system, the total contaminant burden is measured within the cylinder defined by the finite cross-sections of the light beam at each end and the length of the beam itself. The contaminant burden is then normalized to a path length of 1 meter.

The ratio technique can be used to estimate emission rates from either point sources or area sources. Use of the ratio technique requires no assumptions about the nature of the plume dispersion. The ratio technique is conceptually very simple to implement. The approach is to release an appropriate tracer at a known controlled flow rate from locations that adequately

simulate the source geometry. Both sulfur hexafluoride (SF_6) and carbon tetrafluoride (CF_4) are good tracers. Assuming that the tracer and source plumes are fully contained by the downwind beam, the following ratio applies:

$$C/Q = C_T/Q_T$$

where:

C	=	ground-level crosswind-integrated concentration of contaminant at distance x, g/m^2
C_T	=	ground-level crosswind-integrated concentration of tracer at distance x, g/m^2
Q	=	uniform emission rate of contaminant, g/s
Q_T	=	uniform emission rate of tracer, g/s.

This equation simply states that the ratio of the path-integrated concentration of the contaminant to its emission rate is equal to the ratio of the path-integrated concentration of the tracer to its emission rate. It is important to note that all concentrations must be expressed in unit of grams per square meter (g/m^2) or milligrams per square meter (mg/m^2) prior to using the ratio. Then it can be converted back to ppm-m values. Use of ppm-m units will yield erroneous results because molecular weights are not accounted for. Rearranging the equation and solving for Q yields:

$$Q = Q_T C/C_T.$$

2.7.2 Monitoring Strategy

OP-FTIR Spectrometer was utilized to monitor gaseous emissions during the test excavations. Emission rates monitoring for ammonia, ethyl thiocyanate, ethyl isothiocyanate, carbonyl sulfide, and carbon disulfide was conducted. The OP-FTIR Spectrometer analysis was subcontracted to Carala Air Associates, Inc. After mobilizing to the site, background measurements were performed before any excavation activity took place. A portable automated 3-meter system was dedicated to collect the meteorological data.

2.7.3 Sequence of Monitoring Activities

The OP-FTIR monitoring was conducted downwind of the excavation activities. A collection of co-added spectra was made to examine emissions over time and to assess gaseous target contaminants released during waste agitation and subsequent off-gassing from excavated waste piles. The potential beam path configurations were determined on site prior to excavation events. The monitoring configurations were selected based on actual atmospheric transport conditions, and were defined to ensure maximum plume containment. Controlled tracer gas releases were made adjacent to the excavation location in the crosswind direction to accurately simulate emissions excavation activities, when possible.

2.7.4 OP-FTIR System

The OP-FTIR system for this project was a unit manufactured by AIL Systems. The system consists of an IR source, Michelson interferometer, beam splitter, helium-neon laser for beam alignment, collimating telescope, and a mercury-cadmium-telluride (MCT) detector. The spectra collected during monitoring were compared to library spectra for the chemical compounds of interest so the compounds present could be identified and quantitated. A software package was used to facilitate the compound analysis and comparison (via a least-squares-fit spectral matching subroutine) to a reference spectra library stored in the system. Preliminary data analysis was performed in the field using the project-specific analysis routine

to achieve data requirements of near real-time reporting of concentrations and generation of daily summary reports.

2.7.5 Meteorological Monitoring

Carala Air Associates performed independent meteorological monitoring during all air measurements to document contaminant transport and dispersion, and to assess the degree of horizontal plume capture by the open-path spectrometer. A portable 3-meter tower equipped with sensors to measure wind speed, wind direction, temperature, relative humidity, and barometric pressure was utilized. The system calculated the standard deviation of the horizontal wind direction (sigma theta) to assess the atmospheric stability (classes A through D) during monitoring activities. The stability classes were used in modeling to calculate emission rates. The meteorological system was manufactured by Climatronics Inc.

Measurements were collected every 0.5 second by the meteorological sensors and stored within a data logger manufactured by Campbell Scientific, Inc. The data logger was programmed to calculate and store 5-minute averages of the meteorological data which would correspond directly to the OP-FTIR and monitoring periods. Communication with the meteorological system was accomplished by two methods. A hand-held interface, manufactured by Campbell Scientific, Inc., was used to instantaneously assess meteorological conditions and check various sensors. Hard-wire cable linked the meteorological station directly to an IBM portable computer, which was used to interrogate the data logger and obtain the 5-minute averages on a near real-time basis.

2.7.6 Tracer Gas Release

The tracer gas release equipment employed during the open-path air monitoring program consisted of a pressure controlled delivery system, which was assembled and leak-checked daily on site. The materials comprising the tracer gas release system were brass, teflon, stainless steel (316), glass, rubber, and plastic (PVC). The tracer gas chosen for this project was carbon tetrafluoride (CF_4) because it is an inert gas and the OP-FTIR spectrometer is extremely sensitive to it (0.03 ppm-m theoretical MDL) with a strong absorption peak in the IR region between 1274 and 1286 cm^{-1}.

A rotameter with a nominal air flow between 0 and 5 liters per minute was used to monitor the tracer gas release. The rotameter calibrated for CF_4 was supplied by Scott Specialty Gases. The needle valve incorporated in the CF_4 delivery system was used to set the flow on the rotameter corresponding to the emission rate desired and maintain the specified flow rate during the release event.

Tracer releases were conducted to coincide with OP-FTIR monitoring measurement events. The release funnel was placed upwind adjacent to the excavation pit, CF_4 releases were initiated 60 to 90 seconds prior to data collection and continued until data collection was complete. During each release event, the CF_4 flow rate was periodically monitored and adjusted as necessary to maintain a desired path-integrated concentration, for this project between 1.0 and 6.0 ppm-m. The emission rates were obtained through the use of the rotameter calibration curve, which relates the flow and emission rate for the tracer. The tracer gas emission rates were used as input into a software package that was designed to calculate the emission rate of target compounds based on meteorological conditions and information concerning the tracer gas.

3.0 RESULTS

3.1 TAGA Monitoring

TAGA monitoring for the target compounds was performed at the selected locations during normal working hours for the period 23-25 April 1996. All monitoring events recorded a maximum instantaneous concentration below the quantitation limit for all of the target compounds. These results are summarized in Table 1. All of the daughter spectra reveal water clusters or hydrocarbon adducts of hydrocarbon fragment ions. These results are in agreement with all other analytical technologies utilized during this mobilization.

3.2 Sector Sampling

Sector SUMMA canister sampling at the Halby Chemical site was conducted on 23 and 24 April 1996. On 23 April 1996, four sector samplers (Locations 1 through 4) were placed around the areas of excavation. The wind direction sensor was positioned to align with magnetic south. Flow controllers were adjusted to sample at a flow rate of 10 cc/min into the SUMMA canister. Samplers were warmed-up for approximately 30 minutes while checking the voltage outputs provided by the meteorological sensors to the Rustrak data loggers. The meteorological sensors have 0 to 5.0 volt outputs which are monitored/recorded by the data loggers. For the wind direction sensor, 0.0 volts is equivalent to north, 2.5 volts is equivalent to south and 5.0 volts is again equivalent to north. For the wind speed sensor, 0.0 volts is equivalent to 0 miles per hour (mph) and 5.0 volts is equivalent to 100 mph. "In" and "out" sectors were established daily based upon site activities and predicted meteorological forecasts. The wind speed threshold (wind speed needed to be considered "in sector") was set at 1 mph. The wind direction "in sector" was set from east to west [090 (1.25 volts) to 270 (3.75 volt) degrees magnetic]. Sampling was conducted for approximately eight hours.

On 24 April 1996, sampling locations 1 and 2 were removed and only locations 3 and 4 used. The wind direction "in sector" was set from the southwest to the northeast (225 [3.12 volts] to 045 [0.63 volts] degrees magnetic). All other parameters and operation remained the same as the previous day. Sampling was conducted for approximately ten hours.

Samples were analyzed for VOCs at the ERTC/REAC laboratory, Edison, NJ by GC/MS following methods outlined in *Compendium of Methods for the Determination of Toxic Organic Compounds in Air*, EPA 600/4-84-041, April 1984. A modification to the method was made with the addition of carbon disulfide and carbonyl sulfide as target analytes. According to the analytical results, there were no target compounds detected at concentrations above the quantitation limit. On 23 April 1996, trichloroethylene was detected below the quantitation limit at Location 1, Location 2, and Location 3 during monitoring. Estimated concentrations were 2 parts per billion by volume (ppbv/v), 4.9 ppbv/v, and 3 ppbv/v respectively. On 24 April 1996, no target compounds were detected. These results are summarized in Table 2. A review of the non target compounds include acetaldehyde, acetone, and numerous hydrocarbons at low level concentrations. The associated trip blanks for these samples also contained acetaldehyde and acetone. The non-target compound reports are located in the appendix.

3.3 SUMMA Canister "Grab" Sample Results

Samples, along with quality assurance samples (field and trip blanks), were analyzed for VOCs at the ERTC/REAC laboratory, Edison, NJ by GC/MS following methods outlined in *Compendium of Methods for the Determination of Toxic Organic Compounds in Air*, EPA 600/4-84-041, April 1984. A modification to the method was made with the addition of carbon disulfide and carbonyl sulfide as target compounds. A grab sample taken in Pit 1 on 23 April 1996 indicated the presence of tetrachloroethylene at an estimated concentration of 3 ppbv/v. A second sample, taken at the same location on 25 April 1996 during continuous mixing of the soil, resulted in a tetrachloroethylene

concentration of 7 ppbv/v. Trichloroethylene was found at an estimated concentration of 3 ppbv/v in Pit 4 during excavation activities on 23 April 1996. These results are summarized in Table 3. A review of the non-target compounds identified includes acetaldehyde, acetone, and numerous hydrocarbons at low concentrations. The associated trip blanks for these samples also contained acetaldehyde and acetone. The non-target compound reports are located in the appendix.

3.4 Aromatic and Aliphatic Amine Results

A total of eight silica gel tubes were sampled and analyzed following NIOSH methods 2002 and 2010, Aromatic and Aliphatic Amines. Samples, along with quality assurance samples (lot and field blanks), were packaged and shipped to Clayton Environmental Consultants, Nobi, MI for analysis by gas chromatograph/flame ionization detector (GC/FID). All monitoring events recorded a concentration below the quantitation limit for all of the target compounds. These results are summarized in Tables 4 and 5.

3.5 Carbon Tube Sampling for VOC Results

A total of four carbon tubes were sampled and analyzed following NIOSH methods 1500, 1501, and 1003 for the analysis of hydrocarbons. Samples, along with quality assurance samples (field and trip blanks), were analyzed for VOCs at the ERTC/REAC laboratory, Edison, NJ by GC/MS. All monitoring events recorded a concentration below the quantitation limit for all of the target compounds and there were no non target compounds observed. These results are summarized in Tables 6 and 7.

3.6 Charcoal Tube Sampling for Alcohol Results

A total of three charcoal tubes were sampled and analyzed following NIOSH methods 1403, Alcohol IV. Samples, along with quality assurance samples (lot and field blanks), were packaged and shipped to Clayton Environmental Consultants, Nobi, MI for analysis by GC/FID. All monitoring events recorded a concentration below the quantitation limit for all of the target compounds. These results are summarized in Table 8.

3.7 OP-FTIR Monitoring

OP-FTIR monitoring for the target compounds was performed at the selected locations during normal working hours for the period 23-25 April 1996. All monitoring events recorded concentrations below the quantitation limit for all of the target compounds. These results are summarized in Table 9.

4.0 DISCUSSION OF RESULTS

All technologies utilized during this mobilization failed to identify a compound above its odor threshold. While there were reports of odors by site personnel during soil disturbance activities, no single contaminant was confirmed as the origin of these odors. The unknown compound may not have been detected due to any of the following factors: 1) The compound may not have been retained by the collection media or may have been lost during the recovery of the sample from the media. 2) The analytical methodology chosen may not have been optimal. 3) The compound may have broken down in the hot injection port of a GC or reacted with the solvent used in the method. 4) The instrument's detector may not have been responsive to the compound or the instrumental detection limit may be too high.

Table 10 contains a summary of the compounds identified in the samples and their odor thresholds. The odor thresholds were taken from the 1989 American Industrial Hygiene Association's publication, *Odor Thresholds for Chemicals With Established Occupational Health Standard.* This document offers a brief review of the sensory properties of odor, some of the attributes of human olfactory response, and a table of 182 chemicals along with a description of their odors, odor threshold, and their exposer threshold limit value (TLV).

Tables

TABLE 1
TAGA Monitoring Results
Halby Chemical Site
Wilmington, DE
July 1996

SAMPLE LOCATION DATE SAMPLED	Location 1 4/23/96	Location 2 4/23/96	Location 3 4/23/96	Location 4 4/23/96
	ND	ND	ND	ND

SAMPLE LOCATION DATE SAMPLED	Location 5 4/23/96	Location 1 4/24/96	Location 2 4/24/96	Location 1 4/25/96
	ND	ND	ND	ND

ND - None detected

TABLE 2
Sector SUMMA Canister Samples
Halby Chemical Site
Wilmington, DE
July 1996

SAMPLE NUMBER	02567	02568	02569	02570	02594	02595
SAMPLE LOCATION	Location 1	Location 2	Location 3	Location 4	Location 3	Location 4
DATE SAMPLED	4/23/96	4/23/96	4/23/96	4/23/96	4/24/96	4/24/96
DETECTION LIMIT	2 ppbv/v	5 ppbv/v	2 ppbv/v	5 ppbv/v	2 ppbv/v	2 ppbv/v
Trichloroethylene	2 J	4.9 J	3 J	ND	ND	ND

ppbv/v - Parts per billion by volume
ND - None detected
J - Estimated value

TABLE 3
SUMMA Canister Grab Samples
Halby Chemical Site
Wilmington, DE
July 1996

SAMPLE NUMBER	02563	02563 REP	02564	02565	02566
SAMPLE LOCATION	Pit 1	Pit 1	Pit 2	Pit 3	Pit 4
DATE SAMPLED	4/23/96	4/23/96	4/23/96	4/23/96	4/23/96
DETECTION LIMIT	2 ppbv/v	2 ppbv/v	2 ppbv/v	2 ppbv/v	2 ppbv/v
Trichloroethylene	ND	ND	ND	ND	3 J
Tetrachloroethylene	3 J	3 J	ND	ND	ND

SAMPLE NUMBER	02592	02593	02604	02604 REP	02605
SAMPLE LOCATION	E. Room	Pit 1	Pit 1 10:14	Pit 1 10:14	Pit 1 10:30
DATE SAMPLED	4/24/96	4/24/96	4/25/96	4/25/96	4/25/96
DETECTION LIMIT	2 ppbv/v	2 ppbv/v	2 ppbv/v	2 ppbv/v	2 ppbv/v
Trichloroethylene	ND	ND	ND	ND	ND
Tetrachloroethylene	ND	ND	ND	2 J	7

ppbv/v - Parts per billion by volume
ND - None detected
J - Estimated value

TABLE 4
Aromatic Amines In Air
Halby Chemical Site
Wilmington, DE
July 1996

SAMPLE NUMBER SAMPLE LOCATION DATE SAMPLED VOLUME (Liters)	02551 Location 1 4/23/96 75,2	02553 Location 2 4/23/96 76.4	02555 Location 3 4/23/96 82.8	02557 Location 4 4/23/96 83.2
	ND	ND	ND	ND

SAMPLE NUMBER SAMPLE LOCATION DATE SAMPLED VOLUME (Liters)	02580 Location 5 4/24/96 82.4	02582 Location 6 4/24/96 88	02584 Location 7 4/24/96 88.2	02586 Location 8 4/24/96 82.8
	ND	ND	ND	ND

ND - None detected

AR301881

TABLE 5
Aliphatic Amines In Air
Halby Chemical Site
Wilmington, DE
July 1996

SAMPLE NUMBER	02552	02554	02556	02558
SAMPLE LOCATION	Location 1	Location 2	Location 3	Location 4
DATE SAMPLED	4/23/96	4/23/96	4/23/96	4/23/96
VOLUME (Liters)	75.2	76.4	82.8	83.2
	ND	ND	ND	ND

SAMPLE NUMBER	02581	02583	02585	02587
SAMPLE LOCATION	Location 5	Location 6	Location 7	Location 8
DATE SAMPLED	4/24/96	4/24/96	4/24/96	4/24/96
VOLUME (Liters)	82.4	88	88.2	82.8
	ND	ND	ND	ND

ND - None detected

TABLE 6
VOCs In Air
Halby Chemical Site
Wilmington, DE
July 1996

SAMPLE NUMBER SAMPLE LOCATION DATE SAMPLED VOLUME (Liters)	02573 Location 5 4/24/96 216.3	02574 Location 6 4/24/96 216.8	02575 Location 7 4/23/96 217.4	02576 Location 8 4/23/96 5 ppbv/v
	ND	ND	ND	ND

ND - None detected

TABLE 7
Non-Target VOCs In Air
Halby Chemical Site
Wilmington, DE
July 1996

SAMPLE NUMBER	Sample Location	Compound
02573	Location 5	None Detected
02574	Location 6	None Detected
02575	Location 7	None Detected
02576	Location 8	None Detected

TABLE 8
Alcohols In Air
Halby Chemical Site
Wilmington, DE
July 1996

SAMPLE NUMBER	02598	02599	02600
SAMPLE LOCATION	Location 9	Location 10	Location 11
DATE SAMPLED	4/25/96	4/25/96	4/25/96
VOLUME (Liters)	88.5	47.2	47.6
	ND	ND	ND

ND - None detected

TABLE 9
OP-FTIR Results
Halby Chemical Site
Wilmington, DE
July 1996

SAMPLE LOCATION DATE SAMPLED	Location 1 4/23/96	Location 2 4/23/96	Location 3 4/23/96	Location 4 4/23/96
	ND	ND	ND	ND

SAMPLE LOCATION DATE SAMPLED	Location 5 4/23/96	Location 1 4/24/96	Location 2 4/24/96	Location 1 4/25/96
	ND	ND	ND	ND

ND - None detected

TABLE 10
Compounds Identified And Odor Thresholds
Halby Chemical Site
Wilmington, DE
July 1996

COMPOUND	HIGHEST CONCENTRATION DETECTED (ppbv/v)	AIR ODOR THRESHOLD[1] (ppbv/v)
Trichloroethylene	4.9 J	82,000
Tetrachloroethylene	7	47,000
Acetaldehyde	46 JNB	67
Acetone	17 JNB	62,000

ppbv/v - Parts per billion by volume
J - Estimated value
N - Tentatively identified compound
B - Compound detected in blank

[1]American Industrial Hygiene Association. 1989. *Odor Thresholds for Chemicals with Established Occupational Health Standards.* Akron, OH.

APPENDIX
SUMMA Canister Non-Target Compound Reports
Halby Chemical Site
Wilmington, DE
July 1996

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: METHOD BLANK
SAMPLE VOLUME (ml)	: 500.00 (a)	LOCATION	: N/A
QUANTITATION CONCENTRATION (PPB)	: 1030	FRN	: B2215
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: N/A
QUANTITATION SCAN, AREA and RT	: 1274 378721 12.96	DATE ANALYZED	: 04/25/96

Chemical Name	Scan	Area	RT	RRT	ppb
argon + CO2 + C4 alkene	65	13779	1.51	0.12	0.7 *
alkane	127	11113	2.10	0.16	0.6 *

Key to Comments:
* - Below 2.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

Original (red)

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: 02563
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: PIT 1
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82216
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/23/96
QUANTITATION SCAN, AREA and RT	: 1269 378721 12.92	DATE ANALYZED	: 04/25/96

Chemical Name	Scan	Area	RT	RRT	ppb	
acetaldehyde + C4 alkene	58	111638	1.45	0.11	12.1	
acetone	147	181919	2.29	0.18	19.8	
2-methyl-butane	285	21500	3.60	0.28	2.3	*
n-pentane	380	27093	4.50	0.35	2.9	*
2-butanone	397	32332	4.66	0.36	3.5	*
C5 ketone	405	50641	4.74	0.37	5.5	
4-methyl-2-pentanone	806	47204	8.53	0.66	5.1	
3-methyl-2-pentanone	839	39093	8.85	0.68	4.3	
alkane	990	15582	10.28	0.80	1.7	*
C9 alkene/cycloalkane	1008	63029	10.45	0.81	6.9	
alkane	1028	29132	10.64	0.82	3.2	*
alkene/cycloalkane	1036	18049	10.71	0.83	2.0	*
alkene/cycloalkane	1046	15605	10.81	0.84	1.7	*
alkane	1054	19716	10.88	0.84	2.1	*
C9 alkene/cycloalkane	1063	43293	10.97	0.85	4.7	
C9 alkene/cycloalkane	1075	43114	11.08	0.86	4.7	
C9 alkene/cycloalkane	1084	106705	11.17	0.86	11.6	
C9 alkene/cycloalkane	1092	29612	11.25	0.87	3.2	*
alkane	1099	115455	11.31	0.88	12.6	
C9 alkene/cycloalkane	1110	78216	11.42	0.88	8.5	
C9 alkene/cycloalkane	1116	69272	11.47	0.89	7.5	
alkane + m-xylene	1132	18270	11.62	0.90	2.0	*
alkene/cycloalkane	1139	17556	11.69	0.90	1.9	*
C9 alkene/cycloalkane	1154	26171	11.83	0.92	2.8	*
C9 alkene/cycloalkane	1160	40928	11.89	0.92	4.5	
C9 alkene/cycloalkane	1167	25210	11.96	0.93	2.7	*
C9 alkane	1249	152626	12.73	0.99	16.6	
alkane	1259	19692	12.83	0.99	2.1	*
alkene/cycloalkane	1323	24745	13.44	1.04	2.7	*
alkene/cycloalkane	1342	27649	13.62	1.05	3.0	*
alkane	1350	55460	13.69	1.06	6.0	
alkane	1359	42434	13.78	1.07	4.6	
alkene/cycloalkane	1374	30620	13.92	1.08	3.3	*
diene/cycloalkene	1386	22829	14.03	1.09	2.5	*

Key to Comments:
* - Below 4.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: METHOD BLANK
SAMPLE VOLUME (ml)	: 500.00 (a)	LOCATION	: N/A
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82219
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: N/A
QUANTITATION SCAN, AREA and RT	: 1260 376556 12.83	DATE ANALYZED	: 04/26/96

Chemical Name	Scan	Area	RT	RRT	ppb
argon + CO2 + C4 alkene	59	34933	1.46	0.11	1.9 *

Key to Comments:
* - Below 2.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: 02563 REP
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: PIT 1
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82220
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/23/96
QUANTITATION SCAN, AREA and RT	: 1256 376556 12.81	DATE ANALYZED	: 04/26/96

Chemical Name	Scan	Area	RT	RRT	ppb
acetaldehyde	35	108228	1.24	0.10	11.8
acetone	122	178400	2.07	0.16	19.5
2-methyl-butane	265	21165	3.42	0.27	2.3 *
n-pentane	365	28637	4.37	0.34	3.1 *
2-butanone	381	38727	4.52	0.35	4.2
C6 alkene/cycloalkane	390	40658	4.60	0.36	4.4
3-methyl-2-butanone	651	15806	7.08	0.55	1.7 *
C7 alkane	792	55058	8.41	0.66	6.0
alkane	825	29629	8.73	0.68	3.2 *
C6 ketone	929	17383	9.71	0.76	1.9 *
C9 alkene/cycloalkane	994	56589	10.33	0.81	6.2
unknown	1014	29286	10.52	0.82	3.2 *
alkene/cycloalkane	1032	19380	10.69	0.83	2.1 *
C8 alkane	1039	18169	10.75	0.84	2.0 *
C9 alkene/cycloalkane	1049	29529	10.85	0.85	3.2 *
C9 alkene/cycloalkane	1061	31997	10.96	0.86	3.5 *
C9 alkene/cycloalkane	1069	54059	11.04	0.86	5.9
alkane	1085	93301	11.19	0.87	10.2
C9 alkene/cycloalkane	1096	66763	11.30	0.88	7.3
alkene/cycloalkane	1101	51222	11.34	0.89	5.6
alkene/cycloalkane	1125	20589	11.57	0.90	2.3 *
C9 alkene/cycloalkane	1140	25374	11.71	0.91	2.8 *
C9 alkene/cycloalkane	1146	44165	11.77	0.92	4.8
C9 alkene/cycloalkane	1154	30090	11.85	0.93	3.3 *
alkene/cycloalkane + C9 alkane	1235	189837	12.61	0.98	20.8
alkene/cycloalkane + diene/cycloalkene	1246	27260	12.72	0.99	3.0 *
alkene/cycloalkane	1310	36685	13.33	1.04	4.0
alkene/cycloalkane	1329	38640	13.51	1.05	4.2
alkene/cycloalkane	1337	68673	13.58	1.06	7.5
C9 alkane	1346	56065	13.67	1.07	6.1
diene/cycloalkene + C3 alkylbenzene	1356	18016	13.76	1.07	2.0 *
alkane + diene/cycloalkene	1362	34013	13.82	1.08	3.7 *
C8 diene/cycloalkene + alkane	1374	24989	13.93	1.09	2.7 *

Key to Comments:
* - Below 4.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: NALBY CHEMICAL	SAMPLE NUMBER	: 02564
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: PIT 2
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82221
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/23/96
QUANTITATION SCAN, AREA and RT	: 1262 376556 12.87	DATE ANALYZED	: 04/26/96

Chemical Name	Scan	Area	RT	RRT	ppb
acetaldehyde + C4 alkene	40	64507	1.29	0.10	7.1
acetone	129	62414	2.13	0.17	6.8
alkene/cycloalkane + C8 diene/cycloalkene	1243	37681	12.69	0.99	4.1
alkene/cycloalkane	1340	24107	13.61	1.06	2.6 *
alkene/cycloalkane + C9 alkane	1356	11867	13.76	1.07	1.3 *

Key to Comments:
* - Below 4.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: 02565
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: PIT 3
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82222
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/23/96
QUANTITATION SCAN, AREA and RT	: 1267 376556 12.90	DATE ANALYZED	: 04/26/96

Chemical Name	Scan	Area	RT	RRT	ppb
argon + C4 alkene	58	29393	1.45	0.11	3.2 *
acetaldehyde	63	66841	1.50	0.12	7.3
2-methyl-butane	115	18230	1.99	0.15	2.0 *
n-pentane	146	13134	2.28	0.18	1.4 *
acetone	152	49088	2.34	0.18	5.4
acetone + C5 alkene	162	11570	2.43	0.19	1.3 *
2-butanone	382	11951	4.52	0.35	1.3 *
alkene/cycloalkane	1248	21748	12.72	0.99	2.4 *
alkene/cycloalkane	1346	18444	13.65	1.06	2.0 *
alkane + alkene/cycloalkane	1360	11175	13.78	1.07	1.2 *
alkane	1650	10565	16.53	1.28	1.2 *

Key to Comments:
* - Below 4.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: NALBY CHEMICAL	SAMPLE NUMBER	: 02566
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: PIT 4
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82223
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/23/96
QUANTITATION SCAN, AREA and RT	: 1263 376556 12.84	DATE ANALYZED	: 04/26/96

Chemical Name	Scan	Area	RT	RRT	ppb
C4 alkene + CO2	42	58286	1.28	0.10	6.4
2-methyl-butane	94	23790	1.77	0.14	2.6 *
n-pentane	125	16185	2.06	0.16	1.8 *
acetone	133	26438	2.14	0.17	2.9 *

Key to Comments:

* - Below 4.0 ppb limit of quantitation.

(a) - Assumed volume for blank quantitation.

N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: 02567
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: LOCATION 1
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82224
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/23/96
QUANTITATION SCAN, AREA and RT	: 1262 376556 12.86	DATE ANALYZED	: 04/26/96

Chemical Name	Scan	Area	RT	RRT	ppb
acetaldehyde + C4 alkene	46	94153	1.35	0.10	10.3
2-methyl-butane	98	47012	1.84	0.14	5.1
acetone	134	72929	2.18	0.17	8.0
n-pentane + CO2	367	15286	4.39	0.34	1.7 *
unknown	613	19185	6.72	0.52	2.1 *

Key to Comments:
* - Below 4.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: 02568
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: LOCATION 2
QUANTITATION CONCENTRATION (PPB)	: 1030	FRN	: 82225
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/23/96
QUANTITATION SCAN, AREA and RT	: 1264 376556 12.89	DATE ANALYZED	: 04/26/96

Chemical Name	Scan	Area	RT	RRT	ppb
acetaldehyde + C4 alkene	57	88880	1.46	0.11	9.7
2-methyl-butane	108	28104	1.94	0.15	3.1 *
acetone	144	60995	2.28	0.18	6.7
2-butanone	372	11806	4.44	0.34	1.3 *

Key to Comments:
* - Below 4.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: 02569
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: LOCATION 3
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82226
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/23/96
QUANTITATION SCAN, AREA and RT	: 1269 376556 12.88	DATE ANALYZED	: 04/26/96

Chemical Name	Scan	Area	RT	RRT	ppb
C4 alkene + argon	61	26212	1.43	0.11	2.9 *
acetaldehyde	67	184660	1.49	0.12	20.2
alkane	120	41757	1.99	0.15	4.6
acetone	154	153732	2.31	0.18	16.8
n-pentane + CO2	384	28201	4.49	0.35	3.1 *
unknown	554	12926	6.10	0.47	1.4 *
alkane	630	11211	6.82	0.53	1.2 *
pentanal + dibromomethane	685	45651	7.34	0.57	5.0
hexanal	964	29677	9.99	0.78	3.2 *
C5 alkene/cycloalkane	1217	18291	12.38	0.96	2.0 *
alkene/cycloalkane	1455	16269	14.64	1.14	1.8 *

Key to Comments:
* - Below 4.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: METHOD BLANK
SAMPLE VOLUME (ml)	: 500.00 (a)	LOCATION	: N/A
QUANTITATION CONCENTRATION (PPB)	: 1030	FRN	: 82229
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: N/A
QUANTITATION SCAN, AREA and RT	: 1257 375759 12.80	DATE ANALYZED	: 04/29/96

Chemical Name	Scan	Area	RT	RRT	ppb
argon + C4 alkene	60	33629	1.47	0.11	1.8 *

Key to Comments:
* - Below 2.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: 02570
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: LOCATION 4
QUANTITATION CONCENTRATION (PPB)	: 1030	FRN	: B2230
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/23/96
QUANTITATION SCAN, AREA and RT	: 1258 375759 12.81	DATE ANALYZED	: 04/29/96

Chemical Name	Scan	Area	RT	RRT	ppb
C4 alkene + argon + CO2	48	16989	1.35	0.11	1.9 *
acetaldehyde	51	44370	1.38	0.11	4.9
2-methyl-butene	102	20508	1.87	0.15	2.2 *
acetone	140	38903	2.23	0.17	4.3

Key to Comments:

* - Below 4.0 ppb limit of quantitation.

(a) - Assumed volume for blank quantitation.

N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: 02571
SAMPLE VOLUME (ml)	: 500.00	LOCATION	: FIELD BLANK
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82231
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/23/96
QUANTITATION SCAN, AREA and RT	: 1261 375759 12.80	DATE ANALYZED	: 04/29/96

Chemical Name	Scan	Area	RT	RRT	ppb
C4 alkene + argon + CO2	64	26780	1.46	0.11	1.5 *
acetaldehyde	73	13456	1.55	0.12	0.7 *

Key to Comments:
* - Below 2.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: NALBY CHEMICAL	SAMPLE NUMBER	: 02572
SAMPLE VOLUME (ml)	: 500.00	LOCATION	: TRIP BLANK
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 822232
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/23/96
QUANTITATION SCAN, AREA and RT	: 1257 375759 12.81	DATE ANALYZED	: 04/29/96

Chemical Name	Scan	Area	RT	RRT	ppb
acetaldehyde	52	472121	1.39	0.11	25.9
2-propenal	131	18822	2.14	0.17	1.0 *
acetone	140	125014	2.23	0.17	6.9
methyl acetate	215	25688	2.94	0.23	1.4 *
2-butanone	374	18783	4.44	0.35	1.0 *
N-methyl-acetamide + unknown	536	46879	5.98	0.47	2.6
unknown	564	23634	6.24	0.49	1.3 *
N,N-dimethyl-acetamide	638	40522	6.94	0.54	2.2
pentanal + dibromomethane	667	20072	7.22	0.56	1.1 *
unknown	752	22309	8.02	0.63	1.2 *
2,3-dihydro-5-methyl-p-dioxin	879	53302	9.23	0.72	2.9

Key to Comments:
* - Below 2.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: 02592
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: ENGINEER'S ROOM
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82233
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/24/96
QUANTITATION SCAN, AREA and RT	: 1261 375759 12.85	DATE ANALYZED	: 04/29/96

Chemical Name	Scan	Area	RT	RRT	ppb
acetaldehyde	61	212697	1.48	0.12	23.3
acetone	150	51375	2.32	0.18	5.6
methyl acetate	222	17497	3.00	0.23	1.9 *
trimethyl silanol	335	115052	4.08	0.32	12.6
3-methyl-2-butanone	374	16675	4.45	0.35	1.8 *
unknown	1173	19354	12.02	0.94	2.1 *
alkane	1209	10006	12.36	0.96	1.1 *
alkane	1426	12078	14.41	1.12	1.3 *

Key to Comments:

* - Below 4.0 ppb limit of quantitation.

(a) - Assumed volume for blank quantitation.

N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: NALBY CHEMICAL	SAMPLE NUMBER	: METHOD BLANK
SAMPLE VOLUME (ml)	: 500.00 (a)	LOCATION	: N/A
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82239
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: N/A
QUANTITATION SCAN, AREA and RT	: 1263 365601 12.86	DATE ANALYZED	: 04/30/96

Chemical Name	Scan	Area	RT	RRT	ppb
argon + C4 alkene	59	40159	1.46	0.11	2.3
2-methyl-butane	122	10200	2.05	0.16	0.6 *

Key to Comments:
* - Below 2.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME :	WALBY CHEMICAL	SAMPLE NUMBER :	02593
SAMPLE VOLUME (ml) :	250.00	LOCATION :	PIT 1
QUANTITATION CONCENTRATION (PPB):	1030	FRN :	82240
QUANTITAION VOLUME (ml) :	10.00	DATE SAMPLED :	04/24/96
QUANTITATION SCAN, AREA and RT :	1262 365601 12.86	DATE ANALYZED :	04/30/96

Chemical Name	Scan	Area	RT	RRT	ppb
argon + C4 alkene	55	19233	1.42	0.11	2.2 *
acetaldehyde	58	64010	1.45	0.11	7.2
acetone	147	65356	2.30	0.18	7.4
2-butanone + CO2	376	11407	4.47	0.35	1.3 *
n-pentane	399	19092	4.68	0.36	2.2 *
C6 ketone	800	14428	8.48	0.66	1.6 *
C9 alkene/cycloalkane	999	29130	10.37	0.81	3.3 *
alkane	1037	10599	10.73	0.83	1.2 *
C9 alkene/cycloalkane	1055	13290	10.90	0.85	1.5 *
C9 alkene/cycloalkane	1075	14851	11.09	0.86	1.7 *
alkene/cycloalkane + alkane	1092	41370	11.25	0.87	4.7
C9 alkene/cycloalkane	1101	22625	11.34	0.88	2.5 *
alkene/cycloalkane	1109	22220	11.41	0.89	2.5 *
alkene/cycloalkane	1132	10144	11.63	0.90	1.1 *
C9 alkene/cycloalkane	1152	16439	11.82	0.92	1.9 *
C9 alkene/cycloalkane	1159	17388	11.89	0.92	2.0 *
alkane + alkene/cycloalkane	1242	98907	12.67	0.99	11.1
alkane	1252	15932	12.77	0.99	1.8 *
alkene/cycloalkane + BFB	1317	22901	13.39	1.04	2.6 *
alkene/cycloalkane	1336	25615	13.57	1.06	2.9 *
alkene/cycloalkane	1344	48628	13.64	1.06	5.5
alkane + alkene/cycloalkane	1353	45128	13.73	1.07	5.1
alkane	1363	15282	13.82	1.07	1.7 *
alkene/cycloalkane + alkane	1368	30942	13.87	1.08	3.5 *
C8 diene/cycloalkene	1380	24584	13.98	1.09	2.8 *
alkane	1446	10411	14.61	1.14	1.2 *

Key to Comments:

* - Below 4.0 ppb limit of quantitation.

(a) - Assumed volume for blank quantitation.

N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: 02594
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: LOCATION 3
QUANTITATION CONCENTRATION (PPB)	: 1030	FRN	: 82241
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/24/96
QUANTITATION SCAN, AREA and RT	: 1264 365601 12.85	DATE ANALYZED	: 04/30/96

Chemical Name	Scan	Area	RT	RRT	ppb
acetaldehyde	57	60890	1.42	0.11	6.9
acetone	150	32772	2.30	0.18	3.7 *
alkane + alkene/cycloalkane	1245	15733	12.67	0.99	1.8 *
C8 diene/cycloalkene	1342	10131	13.59	1.06	1.1 *

Key to Comments:
* - Below 4.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: MALBY CHEMICAL	SAMPLE NUMBER	: 02596
SAMPLE VOLUME (ml)	: 500.00	LOCATION	: FIELD BLANK
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82245
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/24/96
QUANTITATION SCAN, AREA and RT	: 1267 365601 12.90	DATE ANALYZED	: 04/30/96

Chemical Name	Scan	Area	RT	RRT	ppb
C4 alkene	47	28335	1.35	0.10	1.6 *

Key to Comments:
* - Below 2.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

ORIGINAL (Red)

SITE NAME	: MALBY CHEMICAL	SAMPLE NUMBER	: 02597
SAMPLE VOLUME (ml)	: 500.00	LOCATION	: TRIP BLANK
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82246
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/24/96
QUANTITATION SCAN, AREA and RT	: 1286 365601 13.09	DATE ANALYZED	: 04/30/96

Chemical Name	Scan	Area	RT	RRT	ppb
argon + C4 alkene	58	41674	1.46	0.11	2.3
acetaldehyde	66	20173	1.53	0.12	1.1 *

Key to Comments:
* - Below 2.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: METHOD BLANK
SAMPLE VOLUME (ml)	: 500.00 (a)	LOCATION	: N/A
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: B2250
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: N/A
QUANTITATION SCAN, AREA and RT	: 1260 372787 12.83	DATE ANALYZED	: 05/01/96

Chemical Name	Scan	Area	RT	RRT	ppb
C4 alkene + argon + CO2	61	30083	1.48	0.12	1.7 *
2-methyl-butane	123	10227	2.06	0.16	0.6 *

Key to Comments:

* - Below 2.0 ppb limit of quantitation.

(a) - Assumed volume for blank quantitation.

N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: 02595
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: LOCATION 4
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82251
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/24/96
QUANTITATION SCAN, AREA and RT	: 1255 372787 12.81	DATE ANALYZED	: 05/01/96

Chemical Name	Scan	Area	RT	RRT	ppb
acetaldehyde	20	49507	1.11	0.09	5.5
acetone	47	123018	1.37	0.11	13.6

Key to Comments:
* - Below 4.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME :	HALBY CHEMICAL	SAMPLE NUMBER :	02604
SAMPLE VOLUME (ml) :	250.00	LOCATION :	PIT 1 - 1014
QUANTITATION CONCENTRATION (PPB):	1030	FRN :	82252
QUANTITAION VOLUME (ml) :	10.00	DATE SAMPLED :	04/25/96
QUANTITATION SCAN, AREA and RT :	1256 372787 12.81	DATE ANALYZED :	05/01/96

Chemical Name	Scan	Area	RT	RRT	ppb	
acetaldehyde	52	335629	1.39	0.11	37.1	
acetaldehyde	60	25280	1.47	0.11	2.8	*
2-methyl-butane	105	38781	1.89	0.15	4.3	
n-pentane + C5 alkene/cycloalkane	136	15507	2.19	0.17	1.7	*
acetone	139	111952	2.22	0.17	12.4	
methyl acetate	212	34394	2.91	0.23	3.8	*
alkane	276	19153	3.51	0.27	2.1	*
alkane + unknown	298	16361	3.72	0.29	1.8	*
2-butanone + C6 alkane	370	36536	4.41	0.34	4.0	
unknown	644	15188	7.00	0.55	1.7	*
pentanal + dibromomethane	673	46492	7.28	0.57	5.1	
hexanal	953	23025	9.93	0.78	2.5	*
C9 alkene/cycloalkane	996	44193	10.34	0.81	4.9	
alkene/cycloalkane	1023	15210	10.60	0.83	1.7	*
C9 alkene/cycloalkane	1052	16994	10.87	0.85	1.9	*
C9 alkene/cycloalkane	1063	30985	10.97	0.86	3.4	*
C9 alkene/cycloalkane	1071	16097	11.05	0.86	1.8	*
C9 alkene/cycloalkane	1089	32661	11.22	0.88	3.6	*
C9 alkene/cycloalkane	1097	32069	11.30	0.88	3.5	*
C9 alkene/cycloalkane	1105	17406	11.37	0.89	1.9	*
C9 alkene/cycloalkane	1141	16773	11.71	0.91	1.9	*
C9 alkene/cycloalkane	1148	16357	11.78	0.92	1.8	*
C9 alkene/cycloalkane	1154	40661	11.84	0.92	4.5	
unknown	1170	16593	11.99	0.94	1.8	*
alkene/cycloalkane	1236	60772	12.62	0.99	6.7	
alkene/cycloalkane + BFB	1310	15563	13.32	1.04	1.7	*
alkane	1329	23725	13.50	1.05	2.6	*
alkane	1337	38491	13.57	1.06	4.3	
alkane	1346	33566	13.66	1.07	3.7	*
alkane	1361	25266	13.80	1.08	2.8	*
alkane + C8 diene/cycloalkene	1373	16098	13.92	1.09	1.8	*
alkane	1438	17195	14.53	1.13	1.9	*

Key to Comments:

* - Below 4.0 ppb limit of quantitation.

(e) - Assumed volume for blank quantitation.

N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: NALBY CHEMICAL	SAMPLE NUMBER	: 02604 REP
SAMPLE VOLUME (ml)	: 250.00	LOCATION	: PIT 1 - 1014
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82253
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/25/96
QUANTITATION SCAN, AREA and RT	: 1254 372787 12.78	DATE ANALYZED	: 05/01/96

Chemical Name	Scan	Area	RT	RRT	ppb
acetaldehyde	39	419764	1.27	0.10	46.4
2-methyl-butane	91	34496	1.76	0.14	3.8 *
acetone	126	113748	2.09	0.16	12.6
methyl acetate	197	53201	2.77	0.22	5.9
unknown	285	21775	3.60	0.28	2.4 *
n-pentane	358	37494	4.29	0.34	4.1
N-methyl-acetamide + unknown	532	19795	5.94	0.46	2.2 *
unknown	636	19467	6.93	0.54	2.2 *
pentanal + dibromomethane	666	52451	7.21	0.56	5.8
hexanal	948	23801	9.88	0.77	2.6 *
C9 alkene/cycloalkane	992	47955	10.30	0.81	5.3
C9 alkene/cycloalkane	1047	22746	10.82	0.85	2.5 *
C9 alkene/cycloalkane	1059	24019	10.94	0.86	2.7 *
C9 alkene/cycloalkane	1067	33369	11.01	0.86	3.7 *
C9 alkene/cycloalkane	1076	25104	11.10	0.87	2.8 *
C9 alkene/cycloalkane	1085	52049	11.18	0.87	5.8
C9 alkene/cycloalkane	1094	40463	11.27	0.88	4.5
alkene/cycloalkane	1101	21366	11.33	0.89	2.4 *
C9 alkene/cycloalkane	1138	19758	11.68	0.91	2.2 *
C9 alkene/cycloalkane	1144	19477	11.74	0.92	2.2 *
C9 alkene/cycloalkane	1151	55044	11.81	0.92	6.1
unknown	1166	29990	11.95	0.94	3.3 *
alkene/cycloalkane	1202	18406	12.29	0.96	2.0 *
alkene/cycloalkane	1234	92761	12.60	0.99	10.3
alkene/cycloalkane	1309	32445	13.31	1.04	3.6 *
alkene/cycloalkane	1329	23735	13.50	1.06	2.6 *
alkane + alkene/cycloalkane	1337	49520	13.57	1.06	5.5
alkane + C8 diene/cycloalkene	1346	55115	13.66	1.07	6.1
alkane	1356	19714	13.75	1.08	2.2 *
alkane	1361	39941	13.80	1.08	4.4
alkene/cycloalkane + C8 diene/cycloalkene	1374	33262	13.92	1.09	3.7 *

Key to Comments:
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(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME : HALBY CHEMICAL		SAMPLE NUMBER :	02605
SAMPLE VOLUME (ml) : 250.00		LOCATION :	PIT 1 - 1030
QUANTITATION CONCENTRATION (PPB): 1030		FRN :	82254
QUANTITAION VOLUME (ml) : 10.00		DATE SAMPLED :	04/25/96
QUANTITATION SCAN, AREA and RT : 1261 372787 12.85		DATE ANALYZED :	05/01/96

Chemical Name	Scan	Area	RT	RRT	ppb
acetaldehyde	63	154303	1.50	0.12	17.1
acetone	149	163383	2.31	0.18	18.1
2-butanone	389	43321	4.58	0.36	4.8
C6 alkene/cycloalkane	399	30390	4.68	0.36	3.4 *
C7 alkene	794	44512	8.42	0.66	4.9
C9 alkene/cycloalkane	997	190249	10.35	0.81	21.0
C9 alkene/cycloalkane	1011	42497	10.48	0.82	4.7
C9 alkene/cycloalkane	1025	41742	10.61	0.83	4.6
C9 alkene/cycloalkane	1035	50439	10.71	0.83	5.6
C9 alkene/cycloalkane	1053	75082	10.88	0.85	8.3
C9 alkene/cycloalkane	1065	81706	10.99	0.86	9.0
C9 alkene/cycloalkane	1073	135420	11.07	0.86	15.0
C9 alkene/cycloalkane	1078	57180	11.12	0.87	6.3
C9 alkene/cycloalkane	1082	63266	11.16	0.87	7.0
C9 alkene/cycloalkane + alkane	1089	199304	11.22	0.87	22.0
C9 alkene/cycloalkane	1100	164852	11.33	0.88	18.2
C9 alkene/cycloalkane	1106	74590	11.38	0.89	8.2
C9 alkene/cycloalkane	1129	34970	11.60	0.90	3.9 *
C9 alkene/cycloalkane	1145	72785	11.75	0.91	8.0
C9 alkene/cycloalkane	1150	64993	11.80	0.92	7.2
C9 alkene/cycloalkane	1157	178627	11.87	0.92	19.7
alkene/cycloalkane	1240	317359	12.66	0.99	35.1
alkane	1251	53586	12.76	0.99	5.9
alkene/cycloalkane	1315	96993	13.37	1.04	10.7
alkene/cycloalkane + C8 diene/cycloalkene	1334	81611	13.55	1.05	9.0
alkene/cycloalkane	1337	87424	13.58	1.06	9.7
alkene/cycloalkane + alkane	1342	139367	13.62	1.06	15.4
alkene/cycloalkane	1351	134275	13.71	1.07	14.8
alkane + diene/cycloalkene	1361	58415	13.80	1.07	6.5
alkane	1366	113295	13.85	1.08	12.5
C8 diene/cycloalkene	1378	83588	13.97	1.09	9.2
alkene/cycloalkane + siloxane	1417	104049	14.34	1.12	11.5
C10 alkane	1426	43069	14.42	1.12	4.8
diene/cycloalkene	1480	34078	14.93	1.16	3.8 *

Key to Comments:

* - Below 4.0 ppb limit of quantitation.

(a) - Assumed volume for blank quantitation.

N/A - Not Applicable.

NON - TARGET COMPOUNDS

CANISTER ANALYSIS BY GC/MS

SITE NAME	: HALBY CHEMICAL	SAMPLE NUMBER	: 02606
SAMPLE VOLUME (ml)	: 500.00	LOCATION	: TRIP BLANK
QUANTITATION CONCENTRATION (PPB):	1030	FRN	: 82255
QUANTITAION VOLUME (ml)	: 10.00	DATE SAMPLED	: 04/25/96
QUANTITATION SCAN, AREA and RT	: 1270 372787 12.94	DATE ANALYZED	: 05/01/96

Chemical Name	Scan	Area	RT	RRT	ppb
C4 alkene + acetaldehyde	47	28231	1.35	0.10	1.6 *
alkane	1251	17517	12.76	0.99	1.0 *

Key to Comments:
* - Below 2.0 ppb limit of quantitation.
(a) - Assumed volume for blank quantitation.
N/A - Not Applicable.